J E F F R E Y L. B R U C E & C O M P A N Y

L A N D 3 S T U D I O

LANDSCAPE ARCHITECTURE
CAMPUS PLANNING
URBAN DESIGN

Selecting BMP's for Sites
MoDNR 2012

LAND3
STUDIO
landscape architecture

JBC

Sustainable Development

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Brundtland Report,
*Our Common Future (*1987)

SOCIALLY EQUITABLE

SUSTAINABILITY

ENVIRONMENTALLY SOUND

ECONOMICALLY FEASIBLE

© Sustainable Sites Initiative

Guiding Principles

- Do no harm

- Use the precautionary principle

- Design with nature and culture

- Use a decision-making hierarchy of preservation, restoration and regeneration

- Provide regenerative systems as intergenerational equity

- Support a living process

- Use a systems thinking approach

- Use a collaborative and ethical approach

- Maintain integrity in leadership and research

- Instill a sense of stewardship

Framework: *Ecosystem Services*

Regulate global and local climate

Detoxify and cleanse air, soil and water

Regulate water supply

Control erosion and retain sediment
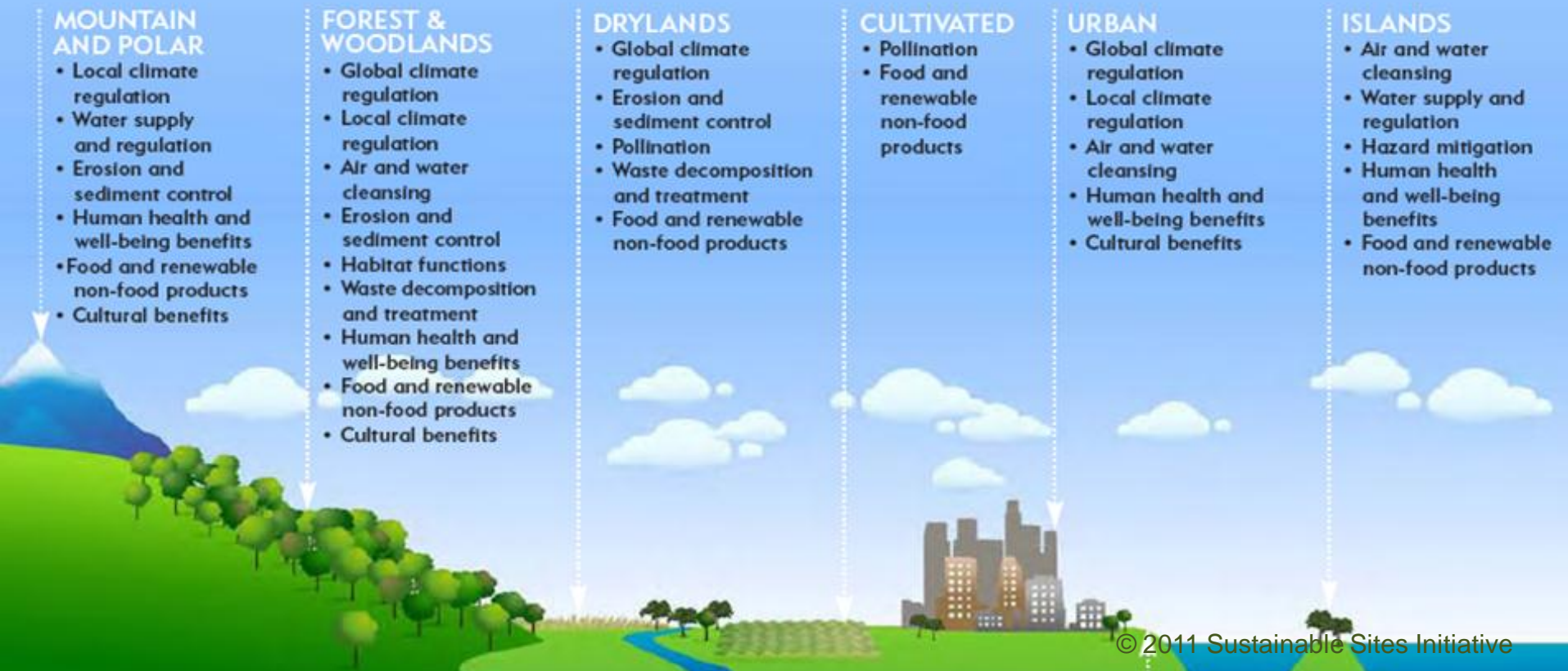
Provide refuge & habitat/ pollination services

Decompose, treat, and re-use waste

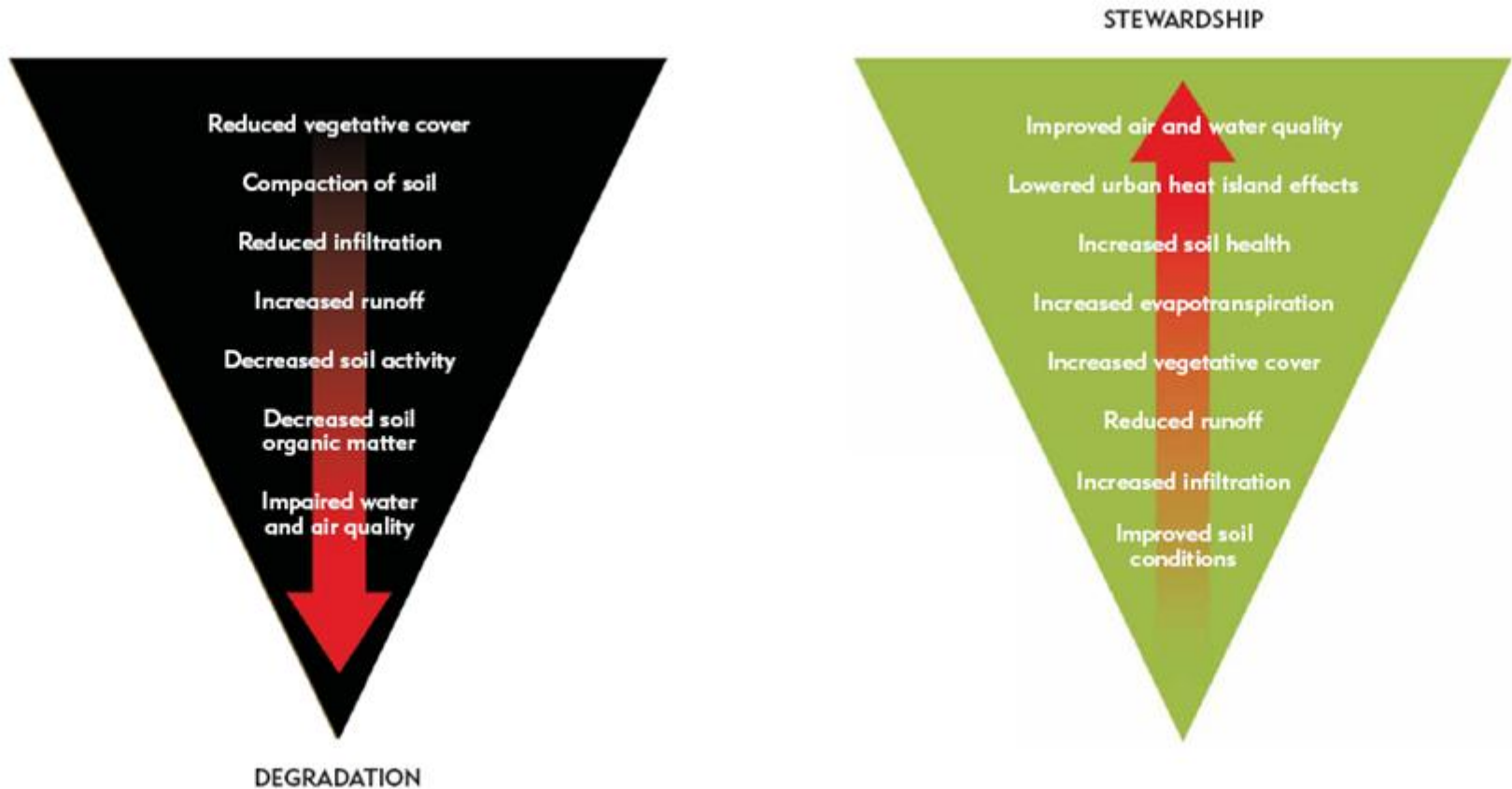Provide human health & well-being benefits

Provide food and non-food products

Provide cultural, educational & aesthetic values

Mitigate potential hazards

MOUNTAIN AND POLAR
- Local climate regulation
- Water supply and regulation
- Erosion and sediment control
- Human health and well-being benefits
- Food and renewable non-food products
- Cultural benefits

FOREST & WOODLANDS
- Global climate regulation
- Local climate regulation
- Air and water cleansing
- Erosion and sediment control
- Habitat functions
- Waste decomposition and treatment
- Human health and well-being benefits
- Food and renewable non-food products
- Cultural benefits

DRYLANDS
- Global climate regulation
- Erosion and sediment control
- Pollination
- Waste decomposition and treatment
- Food and renewable non-food products

CULTIVATED
- Pollination
- Food and renewable non-food products

URBAN
- Global climate regulation
- Local climate regulation
- Air and water cleansing
- Human health and well-being benefits
- Cultural benefits

ISLANDS
- Air and water cleansing
- Water supply and regulation
- Hazard mitigation
- Human health and well-being benefits
- Food and renewable non-food products

Paradigm Change

**Conservation to Regeneration
through High Performance Landscapes**

Best Management Practices

Removal

BMP Value Ratings (4)

- Water Quality (Removal of Solids; TSS) -
- Volume Reduction
- Temperature Reduction
- Oil/Floatable Reduction

*Total Rated Value of (4) = Value Rating(**VR**)*

Reduction

Prevention

TABLE 4.5
Value Rating Calculations

		0	1	2	3	4+
A	Water Quality Value Rating System	0	1	2	3	4+
	Median Concentration of TSS in Effluent (milligrams per liter)	> 100 mg/L	50 - 100 mg/L	20 - 50 mg/L	10 - 20 mg/L	<10 mg/L
B	Volume Reduction Rating System	0	1		2	
		Little or no volume reduction	Moderate infiltration or evaporation		Significant infiltration and evaporation	
C	Temperature Reduction Rating System	-1	0		1	
		Runoff temperature increases	Runoff temperature is unchanged		Runoff temperature decreases	
D	Oils/Floatables Reduction Rating System	0	1		2	
		Little or no oils/floatables reduction	Moderate capture or reduction of oils/floatables		Significant capture or reduction of oils/floatables	

Note:
Value Rating Calculation: VR = A + B + C + D

VR is calculated using the following formula:

$$VR = A+B+C+D$$

Where

A = Water quality value

B = Volume reduction

C = Temperature reduction

D = Oil and grease removal

Note that impervious cover (pavement, roof tops), turf grass lawns, and stormwater management practices that are not designed for water quality treatment such as dry detention basins are not assigned a VR. These cover types and stormwater management practices provide little to no treatment value. BMPs that are not listed in this manual or BMPs that may be custom-designed for a site will not have a VR, of course. However, innovation is not discouraged; designers and reviewers may propose "non-standard" practices based on sound designs and independent monitoring data, and evaluate them against the criteria in Tables 4.4 and 4.5 to assign a VR on a case-by-case basis.

Calculate the area-weighted VR for the overall site using Table 4.4 and Worksheet 2 at the end of Section 4. Begin by assessing the initial site development plan. Multiply the VR scores of any proposed structural BMPs by the catchment area that flows into them, or multiplying the VR for native vegetation by the area of preserved or

APWA / MARC BMP Manual   4-11   August 2009

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Three (3) Main Components to BMP's

- Slope

- Soil Structure

- Water Distribution

Three (3) Main Components to BMP's

- Slope
  - Finished Grade Flat

    Solid Removal, Reduces Volume
  - Finished Grade Sloped

    Medium Solid Removal
  - Flow Line Flat
  - Flow Line Sloped

Finished Grade

Flow Line

Three (3) Main Components to BMP's

- Soil Structure
  - Existing Soils
  - Imported Topsoil
  - Custom Soil Mix (promote infiltration)

    High Solid Removal, Medium Volume Reduction, Oil/Floatable Reduction

Three (3) Main Components to BMP's
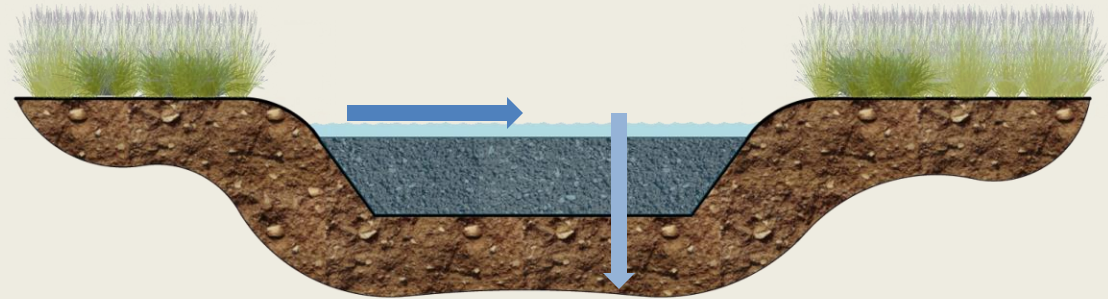
- Water Distribution
    - Horizontal Surface Flow
        - Medium Water Quality
    - Vertical Flow
        - High Water Quality
        - High Oil/Floatable Reduction
    - Retain/Detain
        - High Volume Reduction, Oil/Floatable Reduction

Types of BMP's

- Structural vs. Non-Structural
- MARC Manual: 24 Specific BMP's & 15 General Categories

Non-Structural

Soil Management (Restoration)
Soil Management (Restoration)
Native Vegetation (Restoration or Preservation)
Uplands
Bottomlands and Floodplains
Stream Buffers

Structural

Rain Gardens	Extended Wet Detention
Filtration Basins	Native Vegetation Swale
Infiltration Basins	Extended Dry Detention Basin
BioRetention	Turf Swales
Permeable Pavement	Proprietary Media Filtration
Extended Detention Wetland	Hydro Dynamic Separation
Sand Filters	Catch Basin Inserts
Wetland Swales	Baffle Boxes & Separators
BioSwales	Vegetated Filter Strip

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Types of BMP's

- Structural vs. Non-Structural
- MARC Manual: 24 Defined BMP's

Non-Structural

Soil Management (Restoration)
Soil Management (Restoration)
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Structural

Rain Gardens	Extended Wet Detention
Filtration Basins	**Native Vegetation Swale**
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Permeable Pavement	Proprietary Media Filtration
Extended Detention Wetland	Hydro Dynamic Separation
Sand Filters	Catch Basin Inserts
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Best Management Practices

Rain Garden

- VR Rank: **#2** of 15 Categories
- $10-$15 sf
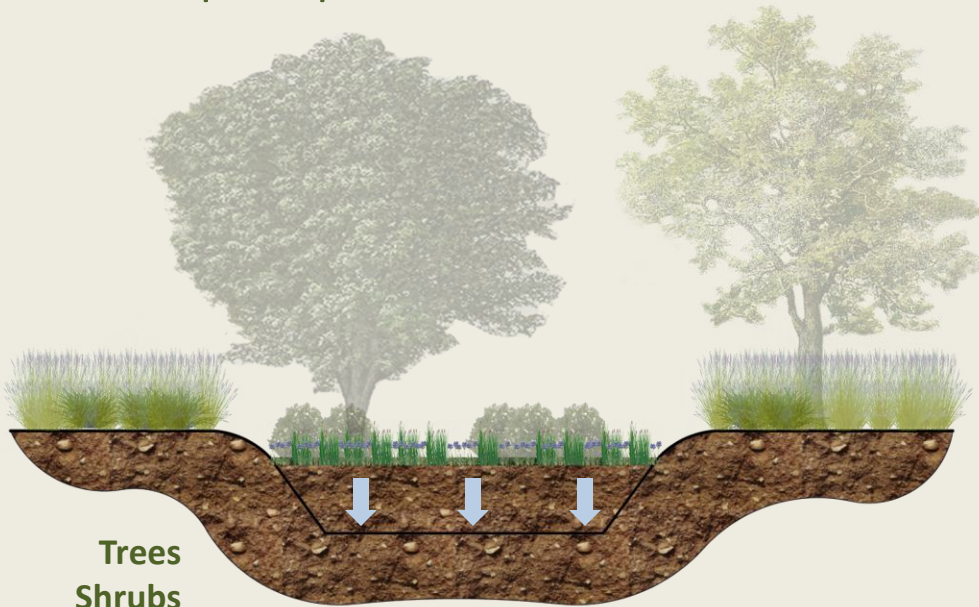
Trees
Shrubs
Plugs
Mulch
Topsoil

Slope
Finished Grade - Flat

Soil Structure
Typical Topsoil

Water Distribution
Horizontal Flow
Retention/Detention

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BioRetention

- VR Rank: **#4** of 15 Categories
- $18-$32 sf

**Plugs
Soil Mix
Gravel Base
Sub Drainage**
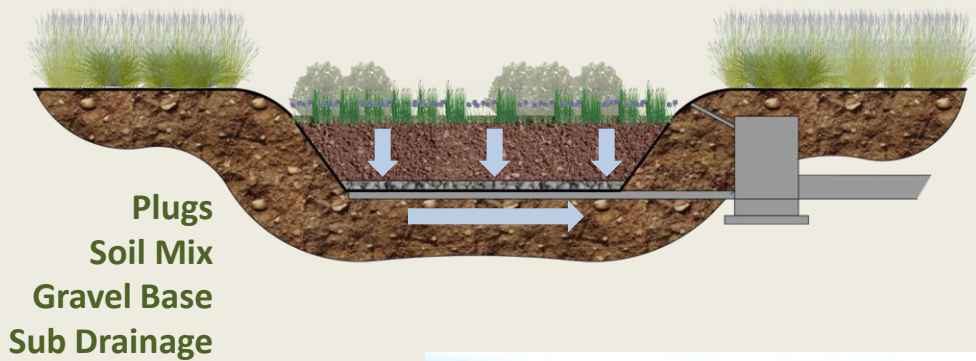
Slope
Finished Grade – Flat
Flow Line - Flat

Soil Structure
Custom Soil Mix

Water Distribution
Vertical Flow
Retention/Detention

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Wetland Swale

- VR Rank: **#7** of 15 Categories
- $7-$14 sf
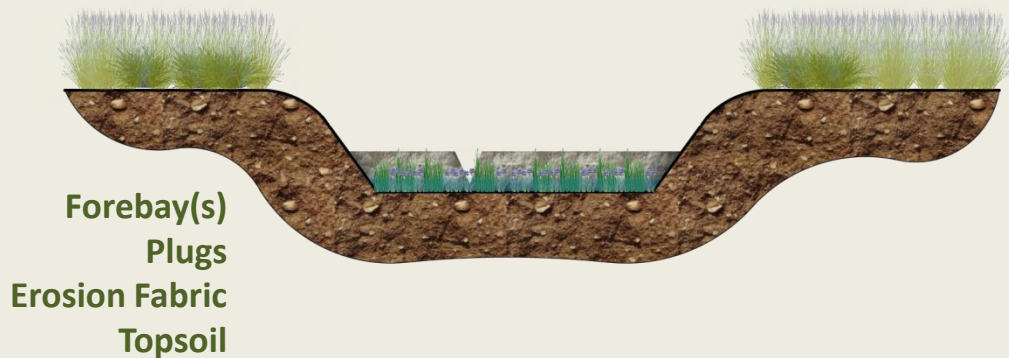
Slope
Finished Grade – Slope

Soil Structure
Typical Topsoil

Water Distribution
Surface Flow

Forebay(s)
Plugs
Erosion Fabric
Topsoil

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BioSwale

- VR Rank: **#8** of 15 Categories
- $18-$25 sf

Plugs
Soil Mix
Gravel Base
Sub Drainage
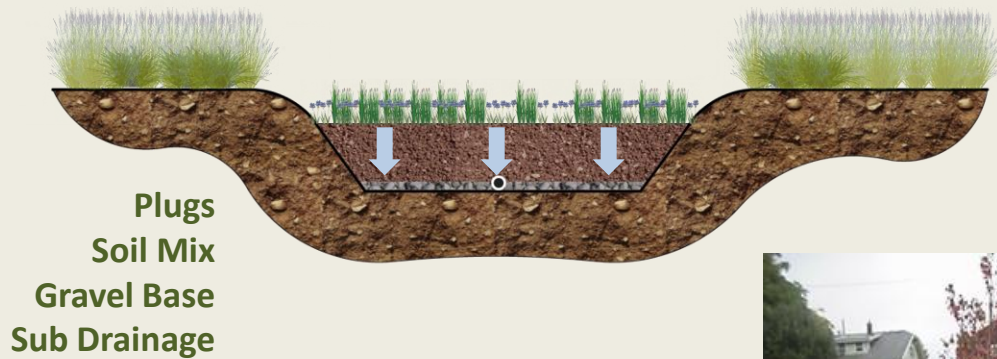
Slope
Finished Grade – Slope
Flow Line - Slope

Soil Structure
Typical Topsoil

Water Distribution
Vertical Flow

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Native Vegetation Swale

- VR Rank: **#12** of 15 Categories
- $8-$15 sf
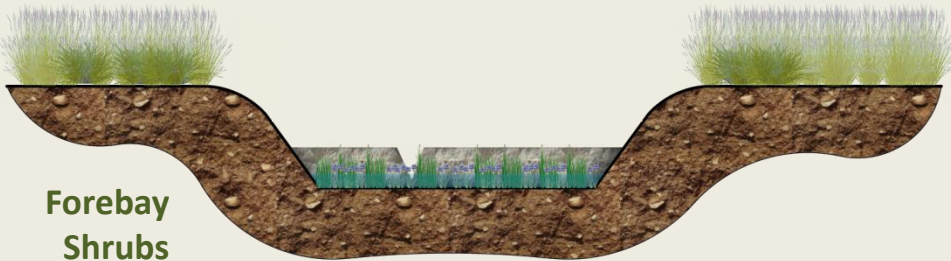
Forebay
Shrubs
Plugs
Erosion Fabric
Native Seed
Topsoil
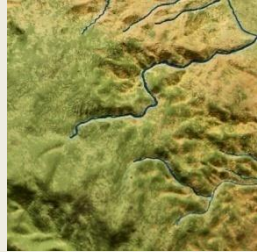
Slope
Finished Grade – Slope

Soil Structure
Typical Topsoil

Water Distribution
Horizontal Flow

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Extended Dry Detention Basin

- VR Rank: **#13** of 15 Categories
- $10-$15 sf
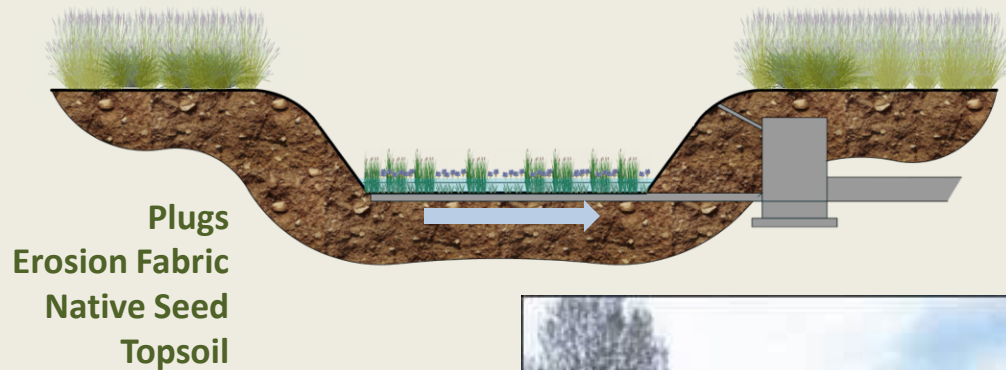
Plugs
Erosion Fabric
Native Seed
Topsoil

Slope
Finished Grade – Flat
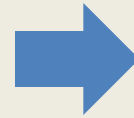
Soil Structure
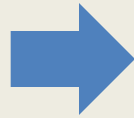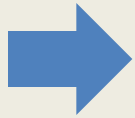Typical Topsoil

Water Distribution
Horizontal Flow
Retention/Detention

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Selecting BMP's

- "Very Easy"
- CN to determine LS by selecting VR's (BMP's) to meet LS
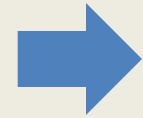
Terms
(CN) Runoff Curve Number
(LS) Level of Service
(VR) Value Rating
(HSG) Hydrologic Soil Groups

PRE vs. POST Development
Impervious vs. Pervious

Selecting BMP's

- **Calculating CN (USDA-NRCS-Technical Release 55)**
  - (Cover Type & Soil Type-HSG) = CN
  - CN x Area (acres) = Product #
  - Total Product Number / Total Area (acres) =
    Runoff Curve Number (Weighted)

  - Note: calculate for both pre and post development
  - Other CN References: APWA 5602.3 or local agency requirements

UNDEVELOPED					DEVELOPED			
Cover Type	**Condition**	**CN by Hydrologic Soil Group (HSG)**			**Cover Type**	**CN by HSG**		
		B	C	D		B	C	D
Fallow, bare soil		86	91	94	Parking lots, roofs, streets with sewer, water, etc.	98	98	98
Fallow, crop residue	Poor	85	90	93	Commercial, business	92	94	95
Fallow, crop residue	Good	83	88	90	Streets: paved, open ditch	89	92	93
Straight row crops	Good	78	85	89	Industrial (or office park)	88	91	93
Contoured crops	Good	75	82	86	Newly graded areas	86	91	94
Contoured and terraced crops	Good	71	78	81	Streets: gravel	85	89	91
Pasture	Poor	79	86	89	Streets: dirt	82	87	89

Terms

(CN) Runoff Curve Number
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(HSG) Hydrologic Soil Groups

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Selecting BMP's

- **Calculating CN (USDA-NRCS-Technical Release 55)**

1. **Runoff Curve Number**

A. **Predevelopment CN**

Cover Description	Soil HSG	CN from Table 1	Area (ac.)	Product of CN x Area
Woods/grass, good	B	55	14.00	770
Straight Row Crop	B	78	20.38	1589
Straight Row Crop	C	85	30.56	2598
Straight Row Crop	D	89	30.56	2720
		Totals:	95.50	7677

Area-Weighted CN = total product/total area =   80   (Round to integer)

Terms
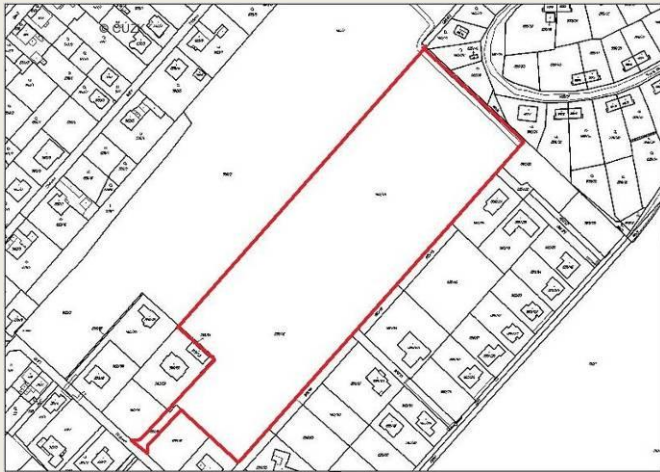(CN) Runoff Curve Number
(LS) Level of Service
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Selecting BMP's

- **Determining LS**
  - LS Range: 0-8 determined by CN pre/post development difference
  - Table in MARC Manual

Change in CN	LS
17 +	8
7 to 16	7
4 to 6	6
1 to 3	5
0	4
-7 to -1	3
-8 to -17	2
-18 to -21	1
-22 -	0

Terms

(CN) Runoff Curve Number
(LS) Level of Service
(VR) Value Rating
(HSG) Hydrologic Soil Groups

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Selecting BMP's

- **Final BMP Selection(s)**
  - Treatment Area (acres) x VR (BMP) = Product
  - Total Product/Total Area (acres) = LS
  - Does it meet required LS?

1. Required LS (from Table 1 or 1A or Worksheet 1 or 1A, as appropriate): | 5 |

Note: Various BMPs may alter CN of proposed development, and LS; recalculate both if applicable.

2. Proposed BMP Option Package No. __1__

Cover/BMP Description	Treatment Area	VR from Table 5 or 6[1]	Product of VR x Area	Notes:
Preserved native vegetation	14.00	9.25	129.50	*(Subtract from site total)*
Streets	19.51	0.00	0.00	*(Subtract from site total)*
Houses/driveways	15.50	0.00	0.00	*(25% of remaining site)*
Turf lawn	46.49	0.00	0.00	*(75% of remaining site*
Total[2]:	95.50	Total:	129.50	
		Weighted VR:	1.36	= total product/total area

[1] VR calculated for final BMP only in Treatment Train.
[2] Total treatment area cannot exceed 100 percent of the actual site area.

Meets required LS (Yes/No)? | NO | (If No, or if additional options are being tested, proceed below.)

Terms
(CN) Runoff Curve Number
(LS) Level of Service
(VR) Value Rating
(HSG) Hydrologic Soil Groups

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